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Standardization of the Growing Media for maximizing Seed Germination of Ber

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ABSTRACT

A field experiment to standardize the growing media for maximizing the seed germination of ber (*Ziziphusmauritiana* var. rotundifolia) was conducted in the nursery of Experimental Orchard, Department of Horticulture, CCS HAU Hisar. The media for the study were garden soil and sand with the different proportion of vermicompost, FYM and cocopeat constituting 16 treatments. The experiment was conducted in randomized block design. The results revealed that growing Media T_7: Garden soil + FYM + VC + CP (3:1:1:1) reduced the number of days for germination (19.33 days) and increased germination percentage (74.60%). The same media also resulted into highest N content in leaves (1.47 %) over all other growing media, in ber seedlings. The data clearly indicated that significantly higher seedling height was observed under T_7 - Garden soil + FYM + VC + CP (3:1:1:1) *i.e.* 22.73, 47.90, 71.57 and 106.43 cm at 60, 90, 120 and 150 DAS, respectively. Therefore, growing Media T_7 - Garden soil+FYM+VC + CP (3:1:1:1) may be recommended for commercial cultivation.

Keywords: *Z. rotundifolia*, Ber, Growing media, Seed germination, Seedlings

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INTRODUCTION

Indian jujube (*Ziziphus mauritiana* var. rotundifolia), commonly known as ber, is one of the important commercial fruit crops grown in arid zone. It is king of arid fruits also known as *Chinese apple or Indian plum* belonging to the family Rhamnaceae. It is considered as poor man's apple since fruits are easily available at low cost of production and rich source of vitamin C, protein and minerals. The fruit is getting great impetus as a commercial crop in the North- Indian states of Punjab, Haryana, Rajasthan and rainfed subtropics of Jammu & Kashmir because of its potential for high yields and excellent economic returns to the growers. The production of the ber can be further increased by increasing area under ber cultivation by making availability of good quality plant material.

Suitable growing media is the pre-requisite or the essential for production of quality ber seedings (Boora, 2016). The rooting system in terms of development and maintenance mainly depend on the growing media (Bhardwaj, 2013 & 2014). Generally, the media are composed of soil, organic matter, pond soil and sand for the fruit crop seedlings. The aim is to increase the porosity, the supplementation of the sand is to be carried out while the organic matter particularly, FYM and vermicompost, is added to enrich adequate nutrients for the seedling. The farm yard manure (FYM) seems to be directly responsible for increasing crop yield as it contains all the essential elements like nitrogen (0.5-1.5%), phosphorus (0.4-0.8%) and potassium (0.5-0.9%). Vermicompost an eco-friendly natural fertilizer prepared from biodegradable organic wastes and rich in macro and micronutrients (Kaur, 2017). Cocopeat is conserved as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes. It exhibited good physical properties high total pore space, high water content, low shrinkage, low bulk density and slow bio-degradation. The initial level of potassium and sodium is usually high in cocopeat, so, the fertilization program should be adjusted carefully according to plant requirements. To grow ber seeds in the combination of soil and sand, FYM, vermicompost and cocopeat, requires careful examination of the growing media in a proportion or along (Abirami *et al.*, 2010). Therefore, the present experiment on the standardization of the growing media for maximizing the germination of ber seed was carried out.

MATERIALS AND METHODS

The present study was conducted in the experimental orchard of Department of Horticulture, in the nursery section by using 16 treatments viz.,T_1 : Garden soil + FYM (1:1), T_2 : Garden soil + Vermicompost (1:1), T_3 : Garden soil + Cocopeat (1:1), T_4 : Garden soil + FYM + Vermicompost (2:1:1), T_5 : Garden soil + FYM+ Cocopeat (2:1:1), T_6 : Garden soil + Vermicompost+ Cocopeat (2:1:1), T_7 : Garden soil + FYM+Vermicompost + Cocopeat (3:1:1:1), T_8 : Garden soil, T_9 : Sand + FYM (1:1), T_{10} : Sand + Vermicompost (1:1), T_{11} : Sand + Cocopeat (1:1), T_{12} : Sand + FYM + Vermicompost (2: 1:1), T_{13} : Sand + FYM+ Cocopeat (2:1:1), T_{14} : Sand + Vermicompost + Cocopeat (2:1:1), T_{15} : Sand + FYM + Vermicompost + Cocopeat (3:1:1:1) and T_{16} : Sand. All the treatments were prepared in three replications and studied in RBD. Garden soil was taken from the Experimental Horticultural orchard (Fig. 1, 2 & 3). Sand

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was procured from local source near the orchard. Vermicompost was procured from Department of Agronomy. Cocopeat was purchased from *Kanta Enterprises*. The combinations were prepared according the treatment details as given above. The available N (kg/ha) was estimated with Alkaline permanganate method as proposed by Subbiah and Asija (1956). For the determination of available phosphorus in soil the Olsen 's method (Olsen *et al.*, 1954) was used for neutral – alkaline soil in the present study. The available potassium was estimated by using the Flame photometric method, USDA Hand Book (Jackson, 1973). Observations were taken after emergence of seedling from the seeds sown and collaboration with Department of Soil Science. Numbers of days taken to germination were noted after the date of sowing and germination percentage was worked out with the following formula: -

Fig. 1: Placement of ber seeds

Fig. 2: Germinated ber seeds

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sowing}} \times 100$$

Data recorded during the study was statistically analyzed by applying the the randomized block design (RBD) for analysis of variance (ANOVA). OPSTAT (Sheoran, 2010) statistical software was used for all the statistical analysis.

Fig. 3: Ber seedling growth

RESULTS AND DISCUSSION

Media analysis

Available NPK: The different treatments resulted in significant increase in available N, P and Kin different media (Table 1). The results pertaining to available nitrogen in media after growing the ber seedlings which clearly showed that treatment T_7 : Garden soil + FYM + VC + CP (3:1:1:1) resulted into significantly higher available nitrogen (165.7 kg/ha) as compared to all other media treatments. The combination of FYM, vermicompost and cocopeat in 3:1:1:1 found to be effective in improving the available nitrogen status of the media (garden soil/sand). The deciding component was found vermicompost followed by FYM. In addition to this garden soil showed its effect in improvement of available N as compared to sand. The least available N was observed in T_{16}: Sand (77.7 kg/ha).

The available P status was found statistically samein T_7 and T_{15}*i.e.* 33.0 and 31.8 kg/ha, respectively. The lowest available phosphorus was estimated in T_{16}: sand (9.1 kg/ha). FYM and vermicompost contributing in higher available phosphorus in both types of substrates *i.e.*, garden soil as well as in sand. Data on available potassium (K) status of the media after growing the seedlings of ber revealed that T_7 and T_{15} were statistically at par in terms of available K and were 267.0 and 262.8 kg/ ha, respectively. T_7 was found significantly superior to improve the available K content in soil over all other treatment. However, vermicompost with 2 proportions found superior over 2 portions of FYM in the treatment T_{13}: Sand + FYM + CP (2:1:1). These results revealed that vermicompost applied in the media was improving the available K status of the soil followed by FYM. The lowest available K was recorded in T_{16} : (223.5 kg/ha).

Table 1: Available N, P and K (kg/ha) in different media

Treatments	Available N	Available P	Available K
T_1	127.0	18.7	231.6
T_2	130.6	21.8	241.8
T_3	123.3	12.0	231.4
T_4	139.5	30.5	248.1
T_5	135.5	22.4	242.9
T_6	152.0	31.4	254.4
T_7	165.7	33.0	267.0
T_8	112.0	9.4	223.6
T_9	125.5	16.1	231.5
T_{10}	128.5	21.6	241.2
T_{11}	117.3	11.9	227.0
T_{12}	137.0	28.2	245.7
T_{13}	133.0	21.9	241.9
T_{14}	146.5	31.3	254.4
T_{15}	159.0	31.8	262.8
T_{16}	77.7	9.1	223.5
CD at 5%	**6.2**	**1.6**	**8.3**

Treatments:T_1 : Garden soil + FYM (1:1), T_2 : Garden soil + Vermicompost (1:1), T_3 : Garden soil + Cocopeat (1:1), T_4 : Garden soil + FYM + Vermicompost (2:1:1), T_5 : Garden soil + FYM+ Cocopeat (2:1:1), T_6 : Garden soil + Vermicompost+ Cocopeat (2:1:1), T_7 : Garden soil + FYM+Vermicompost + Cocopeat (3:1:1:1), T_8 : Garden soil, T_9 : Sand + FYM (1:1), T_{10} : Sand + Vermicompost (1:1), T_{11} : Sand + Cocopeat (1:1), T_{12} : Sand + FYM + Vermicompost (2: 1:1), T_{13} : Sand + FYM+ Cocopeat (2:1:1), T_{14} : Sand + Vermicompost + Cocopeat (2:1:1), T_{15} : Sand + FYM + Vermicompost + Cocopeat (3:1:1:1) and T_{16}: Sand.

The increased available N, P and K status was due to combined effect of vermicompost, FYM and cocopeat in garden soil and sand (Chiranjeevi *et al.,* 2018). Ammonium and ammonium nitrate are present in farm yard manure in sufficient amount and are readily available to crop. FYM supports the higher density of microbial biomass, soil aggregation, organic carbon and total nitrogen. It also improves the quality and growth of the crops. The cocopeat provided the immediate requirement of nutrients along with availability of balanced nutrition and optimum quantity of vermicompost and FYM. Organic matter found in vermicompost and farm yard manure improves the nutrient availability and improves the phosphorus absorption (Gupta *et al.,* 2014). Further vermicompost and FYM might increase the water holding capacity and release of available nutrients to the growing plant. The available nutrients might increase the production of auxin, gibberellings, cytokinins led to overall growth of plants.

Germination of ber seed

Effect of growing media on Days to germination: The data clearly revealed that least number of days (19.33) for seed germination were observed for germination in treatment T_7(garden soil + FYM + VC + CP, 3:1:1:1), while the maximum number of days (31.33 days) for germination were observed in T_{16} (sand). It was found that sand as media in different treatments (T_{14}, T_{15}, T_{13}, T_{12}, T_{11} and T_9) took about 21.67 to 27.33 days to germination and the other media component when added in sand successfully reduced the number of days to germinate in ber (Table 2).

Table 2: Effect of different growing media on germination parameters and leaf nutrient content of ber

Treatments	Germination parameters			Nutrient contents in ber leaves (%)		
	Days to germination	No. of seed germinated	Germination (%)	N	P	K
T_1	26.00	11.54	54.93	1.14	0.15	0.45
T_2	25.67	11.96	56.97	1.19	0.16	0.48
T_3	27.33	10.67	50.80	1.04	0.15	0.43
T_4	24.00	12.71	60.53	1.33	0.17	0.51
T_5	25.33	12.29	58.53	1.23	0.16	0.50
T_6	22.00	14.00	66.67	1.40	0.17	0.52
T_7	19.33	15.67	74.60	1.47	0.19	0.57
T_8	29.67	5.00	23.80	0.94	0.13	0.39
T_9	27.33	11.33	53.93	1.09	0.15	0.44
T_{10}	25.67	11.75	55.93	1.18	0.15	0.47
T_{11}	27.67	10.00	47.63	1.02	0.14	0.40
T_{12}	24.67	12.50	59.53	1.25	0.17	0.51
T_{13}	25.33	12.08	57.53	1.22	0.16	0.49
T_{14}	23.67	12.66	60.30	1.38	0.17	0.51
T_{15}	21.67	14.66	69.83	1.45	0.17	0.54
T_{16}	31.33	4.66	22.20	0.88	0.13	0.38
CD at 5%	**3.31**	**0.50**	**3.58**	**0.26**	**NS**	**NS**

Treatments:T_1 : Garden soil + FYM (1:1), T_2 : Garden soil + Vermicompost (1:1), T_3 : Garden soil + Cocopeat (1:1), T_4 : Garden soil + FYM + Vermicompost (2:1:1), T_5 : Garden soil + FYM+ Cocopeat (2:1:1), T_6 : Garden soil + Vermicompost+ Cocopeat (2:1:1), T_7 : Garden soil + FYM+Vermicompost + Cocopeat (3:1:1:1), T_8 : Garden soil, T_9 : Sand + FYM (1:1), T_{10} : Sand + Vermicompost (1:1), T_{11} : Sand + Cocopeat (1:1), T_{12} : Sand + FYM + Vermicompost (2: 1:1), T_{13} : Sand + FYM+

Cocopeat (2:1:1), T_{14} : Sand + Vermicompost + Cocopeat (2:1:1), T_{15} : Sand + FYM + Vermicompost + Cocopeat (3:1:1:1) and T_{16}: Sand.

Effect of growing media on Germination *per cent*: The data pertaining to germination per cent of ber seedling under the influence of different growing media are presented in Table 2. There were 21 seeds sown in each replication in each treatment. The data clearly indicate that the significantly higher germination of seeds (15.76) and germination per cent (74.60%) was observed in the treatment T_7 - Garden soil + FYM + VC + CP (3:1:1:1) over rest of the other treatments, which was followed by T_{15} (Sand + FYM + VC + CP (3:1:1:1) and T_6 – Garden soil + VC + CP (2:1:1) with germination of seeds *i.e.* 14.66 and 14.00 and germination per cent *i.e.* 69.83 and 66.67 %, respectively, whereas, lowest germination of seeds (4.66) and germination per cent (22.20 %) was observed from T_{16} (sand). The results indicate that the growing media for ber germination can be taken as vermicompost, FYM and cocopeat along with garden soil and sand, respectively.

This might be due to the reason that vermicompost contains the organic matter which might also improve the nutrient availability and improved the phosphorus absorption which helped in root development (Gupta *et al.*, 2014). This might resulted in the early germination as compared to the media not having vermicompost, FYM or cocopeat. The results are in confirmation with Kaur (2017). Likewise, Dharmveer *et al.* (2016) in *Angelica glauca* find out the effect different growing media on seed germination. They found that the sand + soil + cocopeat + vermicompost (1:1:1:1) showed significant positive effect on seed germination and seedling development and can be treated as best suited growing media. Gawankar *et al.* (2019) studied the effect of different media on seed germination in Jackfruit and reported that a mixture of media having soil + vermicompost + rice husk + cocopeat (1:1:1:1) were exhibited higher germination index (33.72), higher germination value (18.58), maximum seedling vigour index (4.60), showed more percentage of graftable seedlings (91.13%), the highest seed vigour (97.08). Mariappan *et al.* (2014) evaluated *Jatrophacurcas* and *Pongamia pinnata* on germination media, seed germination rates and methodology in different germination medium, such as river sand, quartz sand and vermiculite. They reported that river sand is the best medium for tree seeds planted at 2-cm depth of river sand followed by vermiculite. Prajapati *et al.* (2017) reported in acid lime seedlings cv. Kagzi that growing media soil + cocopeat (1:1) recorded maximum germination percentage (63.27) at 45 DAS and speed of germination (12.47).

N, P & K content in ber leaves: Nitrogen, phosphorus and potassium content in leaves were recorded under different growing media and from the data presented in Table 2 it is evident that phosphorus and potassium content in ber leaves were not affected by the any of the growing media. However, highest phosphorus and potassium content was observed in treatment T_7 -Garden soil + FYM + VC + CP (3:1:1:1). Significantly higher nitrogen content (1.47%) was observed in T_7 - Garden soil + FYM + VC + CP (3:1:1:1) over treatment T_{16} which was statistically at par and closely followed with treatment T_{15}, T_6, T_{14}, T_4, T_{12}, T_5 and T_{13}.Whereas, lowest nitrogen, phosphorus and potassium content in leaves was observed in media T_{16} – sand (0.88, 0.13 and 0.38%). This might be due to higher nutrient availability due to vermicompost. The P and K content were not affected due to same content in the garden soil and the sand. The N being held by the garden soil due to improved physio-chemical properties and the slow release of bio-available nitrates to the plants led to improved N content of the media. In sand, the N might not be held by sand particles and due to its leaching, there was less N content in sand media. The results are in confirmation with the results achieved by Gupta *et al.* (2014) in marigold and Beer and Singh (2015) in straw berry.

CONCLUSION

It can be concluded that Garden soil + FYM + VC + CP (3:1:1:1) growing media can be recommended for commercial cultivation in ber as it resulted significantly higher seedling height *i.e.*, 22.73, 47.90, 71.57 and 106.43 cm at 60, 90, 120 and 150 DAS, respectively.

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